CLAIMS

What is claimed is:

1. A method for modeling a non-linear empirical process, comprising the steps of:

creating an initial model generally corresponding to the non-linear empirical process to be modeled, the initial model having an initial input and an initial output;

constructing a non-linear network model based on the initial model, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

optimizing the non-linear network model based on empirical inputs to produce an optimized model by constraining the global behavior of the non-linear network model.

2. The method of Claim 1, wherein the step of creating the initial model includes specifying a general shape of a gain trajectory for the non-linear empirical process.

3. The method of Claim 1, wherein the step of creating the initial model includes specifying a non-linear transfer function suitable for use in approximating the non-linear empirical process.

4. The method of Claim 3, wherein the non-linear network includes interconnected transformation elements and the step of constructing the non-linear network includes incorporating the non-linear transfer function into at least one transformation element.

5. The method of Claim 4, wherein the step of optimizing the non-linear model includes setting constraints by taking a bounded derivative of the non-linear transfer function.

6. The method of Claim 5, wherein the non-linear transfer function includes the log of a hyperbolic cosine function.

7. The method of Claim 1, wherein the non-linear network model is based on a layered network architecture having a feedforward network of nodes with input/output relationships to each other, the feedforward network having transformation elements; each transformation element having a non-linear transfer function, a weighted input coefficient and a weighted output coefficient; and the step of optimizing the non-linear network model includes constraining the global behavior of the non-linear network model to a monotonic transformation based on the initial input by pairing the weighted input and output coefficients for each transformation element in a complementary manner to provide the monotonic transformation.

8. The method of Claim 1, wherein the step of optimizing the non-linear network model comprises adjusting the optimizing based on information provided by an advisory model that represents another model of the non-linear empirical process that is different from the initial model, the non-linear network model, and the optimized model.

9. The method of Claim 8, wherein the advisory model is a first principles model of the non-linear empirical process.

10. The method of Claim 1, wherein the non-linear empirical process is part of a greater process, and the method further includes the step of deploying the optimized model in a controller that controls the greater process.

11. A computer apparatus for modeling a non-linear empirical process, comprising:

a model creator for creating an initial model generally corresponding to the non-linear empirical process to be modeled, the initial model having an initial input and an initial output;

a model constructor coupled to the model creator for constructing a non-linear network model based on the initial model, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

an optimizer coupled to the model constructor for optimizing the non-linear network model based on empirical inputs to produce an optimized model by constraining the global behavior of the non-linear network model.

12. The computer apparatus of Claim 11, wherein the model creator specifies a general shape of a gain trajectory for the non-linear empirical process.

13. The computer apparatus of Claim 11, wherein the model creator specifies a non-linear transfer function suitable for use in approximating the non-linear empirical process.

14. The computer apparatus of Claim 13, wherein the non-linear network includes interconnected transformation elements and the model constructor incorporates the non-linear transfer function into at least one transformation element.

15. The computer apparatus of Claim 14, wherein the optimizer sets constraints by taking a bounded derivative of the non-linear transfer function.

16. The computer apparatus of Claim 15, wherein the non-linear transfer function includes the log of a hyperbolic cosine function.

17. The computer apparatus of Claim 11, wherein

the model constructor constructs the non-linear network model based on a layered network architecture having a feedforward network of nodes with input/output relationships to each other, the feedforward network having transformation elements, each transformation element having a non-linear transfer function, a weighted input coefficient and a weighted output coefficient; and

the optimizer constrains the global behavior of the non-linear network model to a monotonic transformation based on the initial input by pairing the weighted input and output coefficients for each transformation element in a complementary manner to provide the monotonic transformation.

18. The computer apparatus of Claim 11, further comprising an advisory model that represents another model of the non-linear empirical process that is different from the initial model, the non-linear network model, and the optimized model; and

wherein the optimizer adjusts the optimizing based on information provided by the advisory model.

19. The computer apparatus of Claim 18, wherein the advisory model is a first principles model of the non-linear empirical process.

20. The computer apparatus of Claim 11, wherein the non-linear empirical process is part of a greater process managed by a controller coupled to the optimizer, and the optimizer communicates the optimized model to the controller for deployment in the controller.

21. A computer program product that includes a computer usable medium having computer program instructions stored thereon for modeling a non-linear empirical process, such that the computer program instructions, when performed by a digital processor, cause the digital processor to:

create an initial model generally corresponding to the non-linear empirical process to be modeled, the initial model having an initial input and an initial output;

construct a non-linear network model based on the initial model, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

optimize the non-linear network model based on empirical inputs to produce an optimized model by constraining the global behavior of the non-linear network model.

22. A method for modeling a polymer process; comprising the steps of:

specifying a base non-linear function for an initial model generally corresponding to the polymer process to be modeled, the initial model including an initial input and an initial output and the base non-linear function including a log of a hyperbolic cosine function;

constructing a non-linear network model based on the initial model and including the base non-linear function, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

optimizing the non-linear network model based on empirical inputs to produce an optimized model by constraining the global behavior of the non-linear network model by setting constraints based on taking a bounded derivative of the base non-linear function.

23. A computer apparatus for modeling a polymer process; comprising:

a model creator for specifying a base non-linear function for an initial model generally corresponding to the polymer process to be modeled, the initial model including an initial input and an initial output and the base non-linear function including a log of a hyperbolic cosine function;

a model constructor coupled to the model creator for constructing a non-linear network model based on the initial model and including the base non-linear function, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

an optimizer coupled to the model constructor for optimizing the non-linear network model based on empirical inputs to produce an optimized model by constraining the global behavior of the non-linear network model by setting constraints based on taking a bounded derivative of the base non-linear function.

24. A computer program product that includes a computer usable medium having computer program instructions stored thereon for modeling a polymer process, such that the computer program instructions, when performed by a digital processor, cause the digital processor to:

specify a base non-linear function for an initial model generally corresponding to the polymer process to be modeled, the initial model including an initial input and an initial output and the base non-linear function including a log of a hyperbolic cosine function;

construct a non-linear network model based on the initial model and including the base non-linear function, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

optimize the non-linear network model based on empirical inputs to produce an optimized model by constraining the global behavior of the non-linear network model by setting constraints based on taking a bounded derivative of the base non-linear function.